EEL 3216 Fall Semester

Fundamentals of Power Systems

Instructor:

Instructor: Dr. Reza Arghandeh, Assistant Professor
Office: College of Engineering, B 136

Course Hours: 11:00 am to 12:20 pm on Tuesday and Thursday

Office Hours: 12:30 pm to 1:30 pm on Tuesdays

Outside the office hour with appointment.

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TA:

Name : Jose Cordova

Office : TBA

Hours : 12:30pm to 1:30pm on Monday and Wednesday

Email : jdc13b@my.fsu.edu

Prerequisites:

EEL 3112 *Advanced Circuit Analysis*

Course Description and Scope:

An introduction to the fundamentals of power systems: energy conversion, structure of power systems, power system components. The course covers power apparatus, including transformers, rotating machines, and transmission lines. Analysis tools such as one-line diagram, per-unit representation, efficiency, and regulation. The course will briefly introduce the subjects of power flow and machines used in power systems.

Course Textbook:

Power Systems Analysis-2nd Edition, *Arthur R. Bergen and Vijay Vittal*, Prentice Hall Inc. 2000 (BV-Book)

Reference Textbook:

Electric Machinery and Power System Fundamentals, *Stephen J Chapman*, McGraw Hill 2002 (C-Book)

Power System Analysis and Design, *J Glover, M. Sharma, T. Overbye*, Thompson Learning, 5th Edition (GSO-Book)

Class Schedule:

Tuesdays and Thursdays
11:00 a.m. – 12:20 p.m.
College of Engineering Room B 136

Grading Distribution:

Item	Description	Score %
Quizzes[1]	11 quizzes, one least scores will be dropped.	15
Homework[2]	11 assignments, one least scores will be dropped.	20
Final Presentation[3]	Group project be presented on Dec 1 and Dec 3	15
Midterm Exam	Nov 01, in class, close book with 1 notesheet	25
Final Exam	Dec 6 in class, close book with 1 notesheet	25
Extra credit	Class contribution and related seminars attendance	+5

[1,2] Quizzes are each Tuesday based on reading assignments announced on previous week. Homework assignments be available each Thursday and are due on the next Thursday at 11:00 AM.

[3]Project due is on _____.

Grading Policy

Grading	Letter Grades
90% and above	A
80% - 89.99%	B
70% -79.99%	C
60% -69.99%	D
Below 60%	F

Course Objectives

The successful student will:

Analyze the performance of a simple power system with a single source and single load. For this the student will

i) read a single line diagram and construct a single-phase electrical circuit representation of a three-phase system.
ii) convert delta connections to wye/star connections.
iii) model a load given as a complex power as an impedance.
iv) calculate the phase and line voltages in the circuit.
v) calculate the current flows and voltage drops in the circuit.

Use the per unit system in circuit analysis. For this the student will,

vi) select an appropriate power and voltage bases.
vii) calculate the impedance and current bases.
viii) adjust bases across transformers, taking into account the turns ratio.
ix) convert electrical quantities from engineering values to per unit values and vice versa.
x) convert per unit impedances from one base to another.

Analyze the performance of power apparatus (transformer, transmission line, synchronous machine). For this,

xi) form the electrical circuit model of the device.
xii) account for core losses and winding losses, compute the regulation and efficiency
xiii) calculate the efficiency for various loading levels and power factors.
xiv) calculate the maximum efficiency and required loading.
xv) calculate the full-load voltage regulation for various power factors.

Learn the basics about the machines used in power systems. For this they will
xvi) understand the basic concepts of synchronous machines, induction machines and dc machines
xvii) develop and use models for ac synchronous and induction machines.
xviii) analyze the machine behavior under various system and operating conditions.
xix) calculate the machine's speed, torque, power, and efficiency.
xx) calculate a generator's regulation and power angle.

Apply design concepts by specifying the parameters of a piece of power apparatus to meet system design criteria (e.g., specify the transformer ratings to meet voltage regulation requirements.)

Course Content and Outline

1. Overview of energy systems and energy conversion

2. Complex Power, phasor notation, description of power apparatus, and introduction to one-line diagrams and impedance diagrams

3. The per-unit system of measurements

4. Principles of operation of power transformers, magnetic circuits, the ideal device, losses, equivalent circuits, and applications

5 Transmission line theory, parameters, short-line, medium-line, and long-line models, transmission line representation, two-port networks, power flow

6. Operation of a synchronous generator, characteristics, machine constants, round-rotor and salient pole machines

7. Operation of induction motors, magnetic circuit, slip, equivalent circuit, performance calculation and criteria, machine efficiency

8. Other types of machines- dc machines and electric motors

Policies, Procedures, and Responsibilities

- **Class Attendance and Participation.** Class attendance and participation are very important to learning the material and are required. Class discussions will involve novel solution techniques, modeling helps, and problem solving. It is recommended that **a full scientific calculator** be brought to class. A calculator that can perform complex arithmetic will be most advantageous.
- **Mandatory First Day of Classes Attendance Policy:** Students who do not attend classes on the first day of classes may be dropped from their courses.

- **Homework.** Homework assignments are due one week after being assigned. Completed assignments should be submitted as a PDF file in the course blackboard page. Group study sessions for understanding and solving homework problems is strongly encouraged. However, each student is responsible for her/his own work and turning in the assignment. Homework can not be submitted after the due date.
- **Homework Format.** Submit each HW as one PDF file to the backboard.
- **Quiz.** Quizzes are taken at the beginning of Tuesday sessions. Quizzes are based on reading assignments.
- **Project.** Projects are done in groups. Size of groups and their member will be discussed in the class. The project topic will be selected after students' discussion with instructor during the semester.
- **Tests.** There will be one midterm test during the semester and a comprehensive final exam. The test and the final exam will be closed book and closed notes. There will be no exemptions to taking the final exam. You may bring in one notesheet handwritten (8.5" by 11"), and may use standard calculators.
- **Missed Tests.** If you miss a test without either a certified medical excuse or prior instructor approval, a zero will be averaged into you grade. Test missed with certified medical excuse or prior instructor approval will be dealt with individually. If you miss the final exam without a valid excuse, an F grade will be assigned into your grade.
- **Grade Disputes.** Disputes in grading of homework and tests must be made within one week after the graded work has been returned to the student. The student will have the burden of proof to show why her/his solution method is correct.
- **Calculation of Course Grade.** A weighted average grade will be calculated . It is theoretically possible for everyone in the class to get an A (or an F). Your performance depends only on how you do, not on how everyone else in the class does. It is therefore encouraged to help your classmates in every legal way possible.
- **Consulting with Faculty.** It is strongly encourage that you discuss academic questions with the course instructor and the TA during office hours.
- **Honor Codes.** The FAMU and FSU Honor Codes shall be observed. Students are expected to uphold the Academic Honor Code as published in the associated University Bulletin and Student Handbook. The Academic Honor System is based on the premise that each student has the responsibility (1) to uphold the highest standards of academic integrity in the student's own work, (2) to refuse to tolerate violations of academic integrity in the university community, and (3) to foster a high sense of integrity and social responsibility on the part of the university community. Although study groups are encouraged, all homework and tests must represent work of individual students. Copying of homework, cheating on tests and all other forms of academic dishonesty will not be tolerated. Academic dishonesty will be dealt with by a zero grade for the assignment or test.
- **Syllabus Change Policy**. Except for changes that substantially affect implementation of the grading policy or grading scale, this syllabus is a guide for the course and subject to change without a prior notice.
- **ADA Accommodations and Requirements.** Students with disabilities needing academic accommodations should:

  1. Register with and provide documentation to the Student Disability Resource Center (SDRC).
  2. Bring a letter to the instructor from the SDRC indicating you need academic accommodations. This should be done within the first week of class.

  For more information about services available to students with disabilities, FAMU Students should contact the:

  Learning Development and Evaluation Center (LDEC)

(850) 599-3180

FSU Students should contact the:

Student Disability Resource Center (SDRC)

(850) 644-9566

(This syllabus and other class materials are available upon request.)